Planning the Experiment

Shannon used the sandwich she brought for lunch to do an experiment. She placed her sandwich on a two-pan balance and used standard masses to find its mass. Then she took a bite out of her sandwich and found the mass of the remaining sandwich. Shannon kept taking bites out of her sandwich, each time finding the mass, until her sandwich was gone. She recorded her data in a table like the one below.

Mass of a Sandwich

N Number of Bites	*M* Mass in Grams	Ordered Pairs *(N, M)*
0		
1		
2		

You will repeat Shannon's experiment using a sandwich of your own.

1. What are the two main variables in the experiment?
2. **A.** Which of the two main variables is the manipulated variable? Justify your answer.
   B. Which is the responding variable? Justify your answer.
   C. What letters will you use to stand for the two main variables?
3. Shannon wants to look for patterns in the data to help her make predictions about the number of bites and the mass of the sandwich. What important variables should she keep fixed?

Draw a picture of the experiment. Be sure to identify the variables in your picture. Label the main variables with letters.

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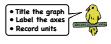
Conducting the Experiment

Make a data table like Shannon's using a blank *Three-Column Data Table*. Label the first two columns with the variables and units. Use the third column for ordered pairs.

4. Collect data for 0, 1, 2, and 4 bites. Record your data in a table like the one Shannon used.

5. Use *Centimeter Graph Paper* to make a point graph of the data in your table.
6. **A.** When the number of bites you took was zero, what was the mass of the sandwich?
   B. Find this data point on your graph. Where is it located?
   C. What is the ordered pair for this point?



7. If the points suggest a line, draw a best-fit line. If they suggest a curve, draw one.
8. Use your graph to estimate the mass of the sandwich after your third bite. Write down your estimate.

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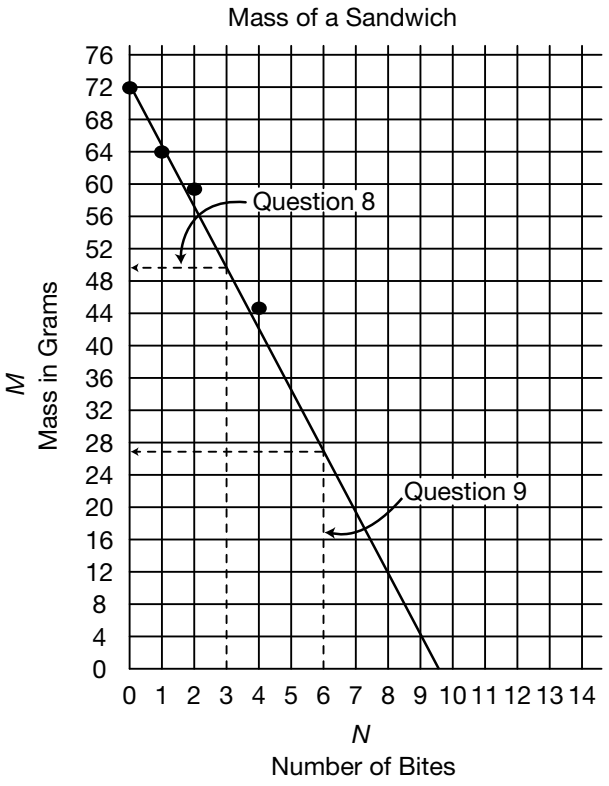
Student Guide

Questions 1–16 (SG pp. 573–576)

1. Number of Bites and Mass
2. **A.*** Number of Bites; I chose the Number of Bites before I started.
   B.* Mass of remaining sandwich in grams; I find the mass when I collect the data.
   C.* N and M
3.* size of bite. The biter and type of sandwich are also fixed variables.
4.* See Figure 2 in Lesson 6 for a sample data table.
5.



Questions 6–11 are answered using the sample graph in Question 5.

Answers will vary based on students' data.

6. **A.*** 72 grams
   B.* The data point is on the vertical axis when the mass is 72 grams.
   C.* (0, 72)
7.* See Figure 3 in Lesson 6 for a sample best-fit line.
8.* About 50 grams.

***Answers and/or discussion are included in the lesson.**

9. A.* About 27 grams.

B.* Answers will vary.

10. A.* The number of bites gets larger as you go down the column. There is a doubling pattern for 1, 2, and 4 bites.

B.* The mass of the sandwich gets smaller as you go down the column.

C.* About 8 grams.

D.* About 8 grams. Possible strategies: If you move one space to the right on the graph, the mass goes down about 8 grams. Or, My sandwich had a mass of 72 grams and it took about 9 bites to finish my whole sandwich. 72 g ÷ 9 bites = 8 grams

11. A.* 10 bites

B.* Answers will vary.

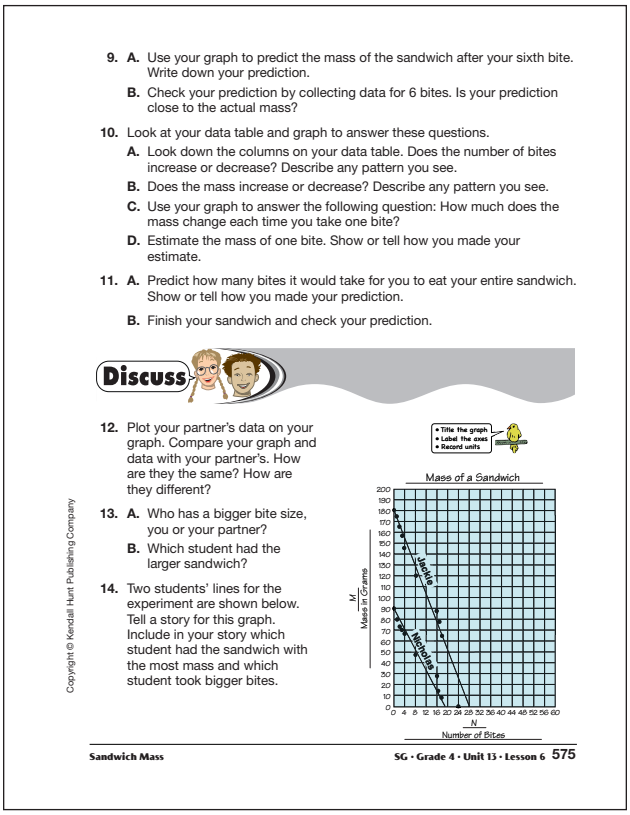
12. Answers will vary.

13. A–B.* Answers will vary. See the lesson for a discussion.

14.* Student stories will vary. Jackie's sandwich had more mass and she took slightly larger bites.

15. A–C.* See Lesson 6 for a description of the graphs.

16. Romesh's graph has a curve instead of a straight line. This is because he took large bites of his apple at first, but they got smaller and he never completely finished his apple. The line on the graph never crosses the horizontal axis.


9. **A.** Use your graph to predict the mass of the sandwich after your sixth bite. Write down your prediction.
B. Check your prediction by collecting data for 6 bites. Is your prediction close to the actual mass?

10. Look at your data table and graph to answer these questions.
A. Look down the columns on your data table. Does the number of bites increase or decrease? Describe any pattern you see.
B. Does the mass increase or decrease? Describe any pattern you see.
C. Use your graph to answer the following question: How much does the mass change each time you take one bite?
D. Estimate the mass of one bite. Show or tell how you made your estimate.

11. **A.** Predict how many bites it would take for you to eat your entire sandwich. Show or tell how you made your prediction.
B. Finish your sandwich and check your prediction.

Discuss

12. Plot your partner's data on your graph. Compare your graph and data with your partner's. How are they the same? How are they different?

13. **A.** Who has a bigger bite size, you or your partner?
B. Which student had the larger sandwich?

14. Two students' lines for the experiment are shown below. Tell a story for this graph. Include in your story which student had the sandwich with the most mass and which student took bigger bites.

• Title the graph
• Label the axes
• Record units

Mass of a Sandwich

M Mass in Grams

Jackie

Nicholas

N Number of Bites

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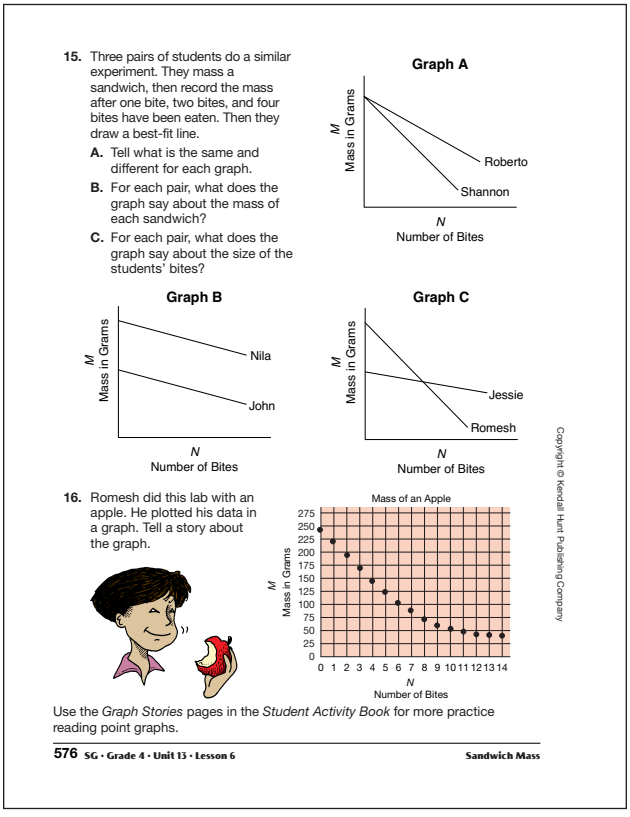
15. Three pairs of students do a similar experiment. They mass a sandwich, then record the mass after one bite, two bites, and four bites have been eaten. Then they draw a best-fit line.
A. Tell what is the same and different for each graph.
B. For each pair, what does the graph say about the mass of each sandwich?
C. For each pair, what does the graph say about the size of the students' bites?

Graph A

M Mass in Grams

Roberto

Shannon

N Number of Bites

Graph B

M Mass in Grams

Nila

John

N Number of Bites

Graph C

M Mass in Grams

Jessie

Romesh

N Number of Bites

16. Romesh did this lab with an apple. He plotted his data in a graph. Tell a story about the graph.

Mass of an Apple

M Mass in Grams

N Number of Bites

Use the *Graph Stories* pages in the *Student Activity Book* for more practice reading point graphs.

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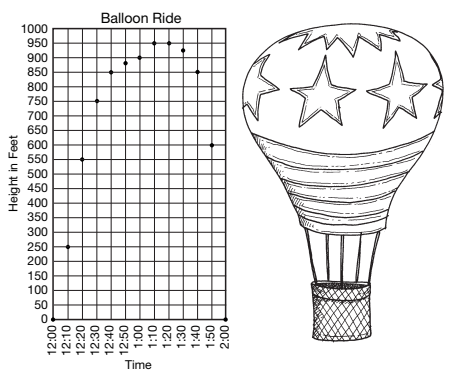
***Answers and/or discussion are included in the lesson.**

Name _____ Date _____

Graph Stories

1.



A. Using the data, tell a story about the height of the balloon during a balloon ride.

B. Do the points form a line? If yes, draw a best-fit line on the graph. If no, describe the shape of the graph.

C. Using this data, can you make a reasonable prediction about the height of the balloon at 12:15? Why or why not?

D. If possible, predict the height of the balloon at 1:45.

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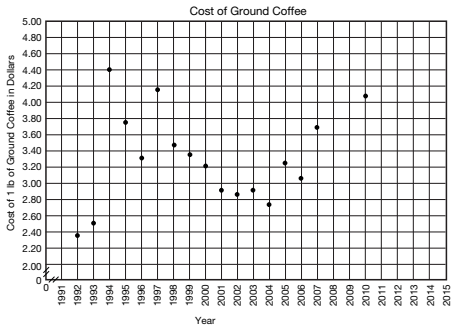
Name _____ Date _____

2.



A. Using the data, tell a story about the cost of ground coffee from 1992 to 2010.

B. Do the points from a line? If yes, draw a best-fit line on the graph. If no, describe the shape of the graph.

C. Can you make a reasonable estimate for the cost of a pound of ground coffee in the year 2008? Explain.

D. If possible, predict the cost of 1 pound of ground coffee in the year 2015. Show or tell how you decide on your answer.

***Student Activity Book* - Page 564**

Student Activity Book

Questions 1–2 (SAB pp. 563–564)

1. **A.** Stories will vary. Possible response: The graph shows that the balloon goes up between 12:00 and 1:10 when it reaches 950 ft. The balloon goes up fast at first, then it levels off. Then the balloon starts to come down at about 1:30.

   B. The points do not form a line, but they do form a pattern. They form a curve where the points go up and then down.

   C. Yes, if you follow the pattern of the curve, then you can predict that the balloon will be between 400 and 450 ft.

   D. About 725 ft.

2. **A.** Stories will vary. Possible response: The graph shows that the cost of coffee went up and down between 1992 and 2010. The cost went up until 1997 when it decreased until 2004 when it started increasing again. There are three points that seem out of place, so it may be that something happened to the coffee crop in 1994, 1995, and 1997.

   B. The points do not form a line. Possible response: The points go up and down like a roller coaster.

   C. Answers will vary, but students must justify their answers. Possible response: The cost of coffee will probably be between the points for 2007 and 2010, so an estimate of about $3.90 would make sense. Or, students might say that the cost of coffee went up and down so much, it would be hard to make a reasonable prediction.

   D. Answers will vary, but students must justify their answers. Students may say that the cost will keep going up as it had since about 2004 and predict that the cost of coffee would be between $4.20 and $4.40. Or, students may say that since the cost varied so much, it will be hard to predict the cost in 2015.

Teacher Guide

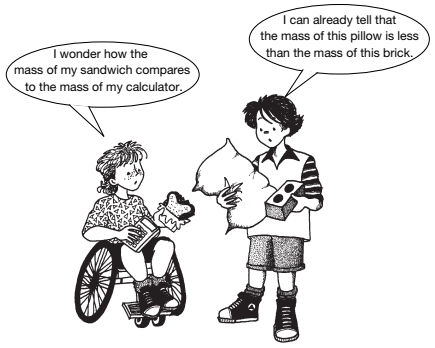
Mass Review* (TG pp. 1–3)

Name _____ Date _____

Mass Review

What is mass?

Mass is the amount of matter in an object. We can get an idea about the mass of an object by lifting it up.



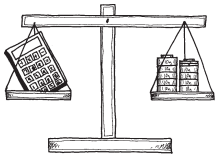
If we want to compare the mass of two things, we can use a two-pan balance. Before we use the balance, we should make sure it is level. We can use a small piece of clay to level the balance by placing it on the side that is higher.

***Teacher Guide* - Page 1**

Name _____ Date _____

In order to measure mass, we need a unit of measure. Common metric units of mass are the gram (g) and the kilogram (kg). A kilogram is 1000 grams. We measure the mass of small objects in grams and the mass of large objects in kilograms.

We can find the mass of an object using the two-pan balance.



Michael used the two-pan balance to find the mass of his calculator. His standard masses have a mass of 1 gram and 10 grams. He found the mass was 92 grams.

1. Use a two-pan balance to find the mass of at least four objects. Record your results in the data table below.

O Object	*M* Mass (in ____) *unit*

Use your data to answer the following questions. Sometimes, you will have to collect more data to provide an answer.

2. Which object has the most mass?
3. Which object has the least mass?

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Name _____ Date _____

4. Compare the mass of the objects from Questions 2 and 3 using words or number sentences.

5. Choose any two of your objects, and use your data to predict the total mass of those two objects together.
   - **A.** Write down the mass of each object and your prediction for the total.
   - **B.** Use the balance to find the actual mass of the two objects together.
   - **C.** Was your predicted mass close to the actual mass? How close?

6. **A.** Put the object with the most mass in one pan. Put the object with the second largest mass in the other pan. Predict how much mass you will have to add to the lighter side to get the pans to balance. Write down your prediction.
   - **B.** Check your prediction by adding mass to the lighter side until the pans balance. Write down the actual number of grams you added to the balance. Is the actual number close to your prediction?

7. Were any of your predictions different from your actual results? On a separate sheet of paper, discuss why that might have happened.

***Teacher Guide* - Page 3**

***Answers and/or discussion are included in the lesson.**

Name _____ Date _____

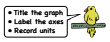
Predictions Quiz

You will need a ruler to complete these questions.

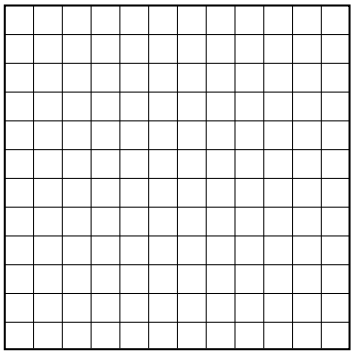
1. Professor Peabody used the Sandwich Mass lab to see how long it took his mouse, Milo, to eat a dish of food. He recorded the data in a table.

   A. Plot a graph for Professor Peabody's data.

   B. If your graph suggests a line, draw a best-fit line.



N Number of Days	*M* Mass in Grams
0	114
1	103
2	91
4	67
6	43
8	22



Assessment Master TG • Grade 4 • Unit 13 • Lesson 6 1

***Teacher Guide* - Page 1**

Name _____ Date _____

2. Tell the story of your graph. What does it tell you about the mass of the food the mouse ate?

3. Predict the mass of the food left in the dish after 3 days. Show or tell how you know.

4. Predict how many days it would take Milo to eat the entire dish of food. Show or tell how you made your prediction.

5. About how much food did Milo eat each day? Show or tell how you know.

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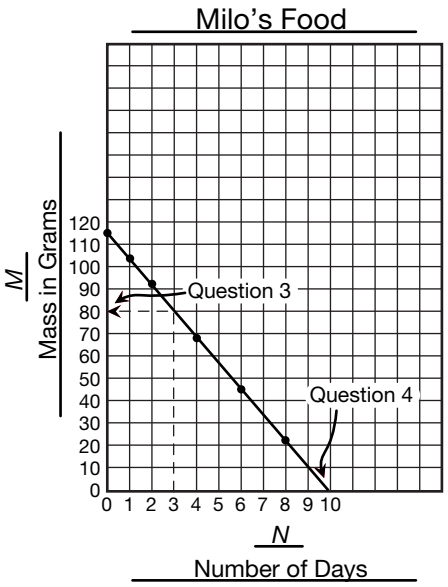
***Teacher Guide* - Page 2**

Teacher Guide

Predictions Quiz (TG pp. 1–2)

Questions 1–5

1.



2. Stories will vary. Stories should include where the graph starts, that the line goes "downhill", and where it ends. Students should connect these observations to the story of Milo and his food. Possible story: The graph starts when the mass equals 114g. That is how much food Milo started with. Milo ate a little each day, so the mass gets less and the graph goes downhill. The dish was empty after 10 days when the line on the graph hits N = 0 days.
3. About 80 grams; see graph above.
4. About 10 days. Strategies will vary. Students can use their graph and see where the line crosses the horizontal axis (M = 0g).
5. Possible response: If it takes 10 days to eat the entire dish of food, then 114 grams in all divided by 10 days is about 11 grams eaten each day. Students can look on the graph and see how much the mass decreases each day. Moving one unit (1day) to the right on the graph shows a move of 10–11 units (grams) down on the line.

***Answers and/or discussion are included in the lesson.**